2. Carbon Cycle Division

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2.1. CONTINUING PROGRAMS

2.1.1. IN SITU CARBON DIOXIDE MEASUREMENTS

The mixing ratio of atmospheric CO_2 was measured with continuously operating NDIR analyzers at the four CMDL observatories during 1993 as in previous years. Monthly and annual mean CO_2 concentrations (in the WMO 1985 mole fraction scale (X85)) are given in Table 2.1. These values are provisional, pending final calibration of station standards. Preliminary selected monthly-average CO_2 mixing ratios for the entire record through 1993 are plotted versus time for the four observatories in Figure 2.1.

TABLE 2.1. Provisional 1993 Monthly Mean CO_2 Mixing Ratios From Continuous Analyzer Data (ppmv, Relative to Dry Air WO X85 Mole Fraction Scale)

Month	BRW	MLO	SMO	SPO
Jan.	362.45	356.79	355.38	354.04
Feb.	361.81	357.13	355.34	354.22
March	363.43	358.23	355.93	354.06
April	363.03	359.14	355.59	354.17
May	363.22	360.05	354.67	354.31
June	360.51	359.37	355.42	354.58
July	351.55	357.22	355.41	355.05
Aug.	347.69	355.31	356.10	355.50
Sept.	349.14	353.81	355.74	355.72
Oct.	354.12	354.03	355.82	355.72
Nov.	358.41	355.20	356.14	355.75
Dec.	360.17	356.70	356.63	355.55
Year	357.96	356.92	355.68	354.89

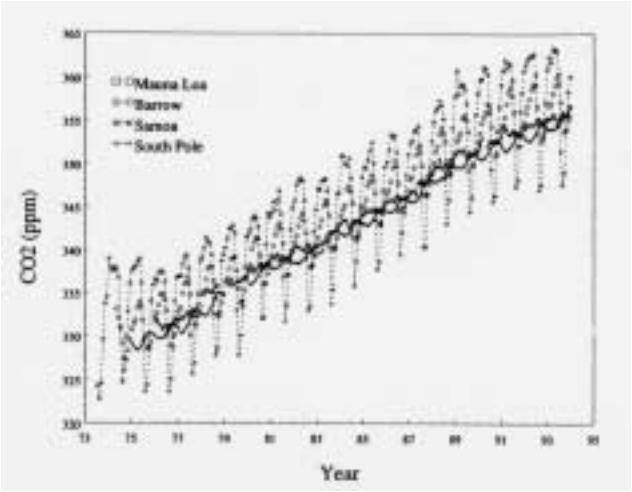

Fig. 2.1. Preliminary selected monthly mean CO_2 mixing ratios at the four CMDL observatories.

The CO_2 in situ systems operated during 1993 from a low of 86.2% at BRW to a high of 97.5% of the year at MLO. SMO and SPO were operational 96.5% of the time. This is based on the number of valid hourly-averaged CO_2 mixing ratios that were calculated for the year, taking into account missing data because of reference gas calibrations during the year. The major loss of data at BRW was due to a mechanical failure in the CO_2 NDIR analyzer in February that was corrected in late March.

The growth rates of CO_2 as measured by the in situ observatory systems, returned to more normal values after showing smaller than average growth rates in 1992. Figure 2.2 shows the instantaneous growth rate at the four CMDL observatories for 1980 through 1993. The BRW growth rate, which typically has greater fluctuations than the other sites, appeared to reach its lowest value in mid-1992, before any of the other sites. The minimum appeared to propagate southward with lesser magnitude, reaching SPO last by the first quarter of 1993.

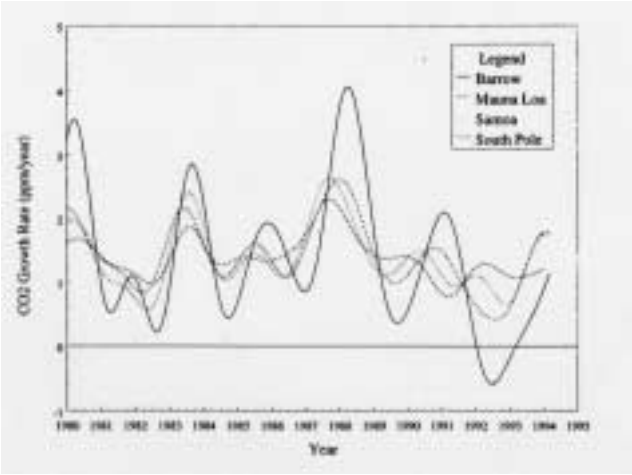

Fig. 2.2. The variation of the CO_2 mixing ratio growth rate for 1980-1993. The curves are the time derivatives of the deseaonalized, smoothed daily mean data for the four CMDL observatories.

New data acquisition systems are planned for the eventual replacement of the CAMS units at the four observatories. Five Hewlett Packard UNIX work-stations were purchased in 1993 that will take over the task of controlling data acquisition not only for the CO_2 in situ system, but for the CH_4 and CO in situ chromatograph systems as well. These computers, with associated equipment, are scheduled to be installed at the observatories starting in 1994. These types of systems will be compatible with the computer systems used in the Boulder laboratory for flask sample analysis and reference gas calibrations, so that software will be identical for all analysis systems throughout the Carbon Cycle Division.